The *Amazing* Human Body

COMPILED BY
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WITH A FOREWORD BY
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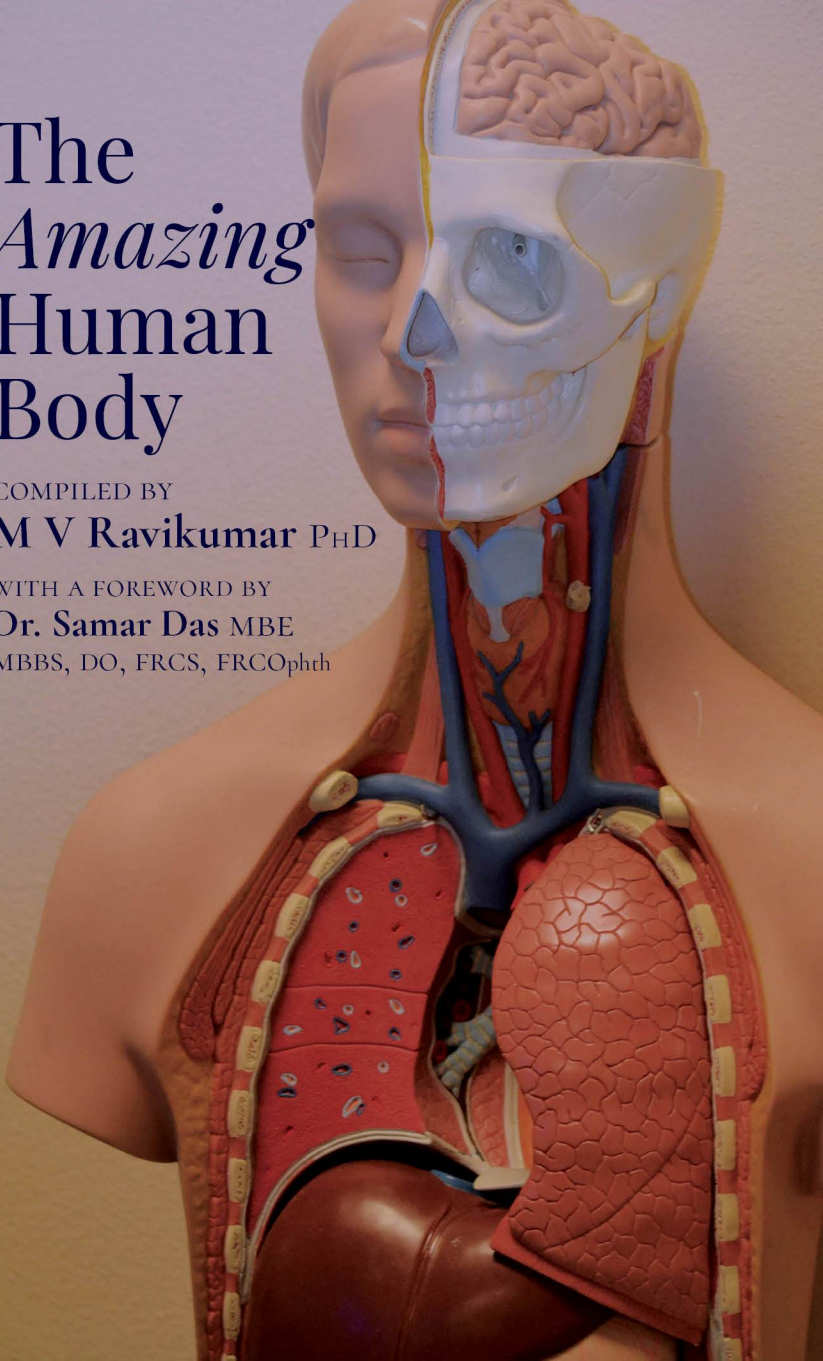

M V Ravikumar (*b.* 1950, Bangalore) initially trained in Electronics and Communication engineering; joined *Indian Telephone Industries Limited* (ITI) as a Research and Development Engineer in 1974. After working there for a decade, he co-founded the manufacturing companies *U. V. Circuits Pvt. Ltd.* and *PAL Technologies Pvt. Ltd.* as well as an export consortium company *Clixport India Pvt. Ltd.*

He was the President of *Consortium of Electronics Industries of Karnataka* (CLIK) during 1989–91. Apart from being a member of the Managing Committee of *Bangalore Management Association* (BMA), he served as the Editor of *Manage*, the house journal of BMA during 2002–4.

Ravi has a PhD in the area of entrepreneurship and has been a consultant to small and medium industries, higher educational institutions, and other organizations. He is the founder-trustee of *Kaveri Trust* (1993) and *Nayana Jyothi Trust* (2010). In 2015, he established *Impact Foundation* to mentor start-ups that create social impact.

He has also been an active member (Rotarian) of *Rotary International* since 1988. For his services to the community (particularly in the area of Avoidable Blindness), he was given the *Service Above Self* award, the highest honour given to any Rotarian.

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Kaveri Trust
Bengaluru

PUBLISHED BY
Kaveri Trust
136 Swami Vivekananda Road
Halasuru, Bengaluru 560008

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FIRST EDITION
October 2020

SECOND EDITION
February 2021

EDITED AND DESIGNED BY
Hari Ravikumar

TYPESET IN
Adobe Caslon Pro

PRINTED AT
Repromen Offset Pvt. Ltd.
#46/47 Krishna Reddy Colony
Domlur, Bengaluru 560 071
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Foreword

I WAS AMUSED to receive this book written by M V Ravikumar, an engineer, on a subject that took me many years of study to be a surgeon all my life.

Soon my amusement turned to amazement after reading the whole book and appreciating how comprehensive and yet concise the compilation is. I would recommend this book to everybody as a "must read" not only for themselves, but also to keep it handy on the bookshelf to answer correctly to the children who by nature are very inquisitive.

This book should also be translated to other Indian languages for the masses.

Guildford,
United Kingdom

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Preface

The human body with its interconnected systems is the most advanced structure in the known universe. It is a marvel of bio-mechanical engineering. Despite millennia of anatomic and biomedical search and discovery, there are parts and functions of the human body that remain a mystery.

In March 1989, when my wife's right knee was swollen and she could neither stand nor take a step forward, I heard about *rheumatoid arthritis* for the first time. There was no internet then, so I had to visit the library to know about the disease.

In June 2020, I heard for the first time about *Pyrexia of Unknown Origin* (PUO) when my elder son had fever for a period of over five weeks and the cause could not be diagnosed. This time, however, the internet was handy and I could learn about PUO sitting in the comfort of my office.

Apart from the above two situations, having myself been afflicted many a time with some disease or the other and undergone a few surgeries, there has always been a compelling need to know more about the body and its functioning.

I decided to compile interesting facts about the various systems and organs of our body (primarily from the information available online) and bring out this booklet, to emphasize that everyone should take care of this 'miracle machine' and be well!*

~

I acknowledge with grateful thanks the contributions of Hari in editing and designing the book and Hema in reviewing the manuscript. Special thanks to my friend Y C Roy for his suggestions to highlight some facts prominently and include a section on the process from conception to birth. My sincere thanks to Rtn. Dr. Samar Das (UK) for readily agreeing to write a Foreword, which adds credibility to this compilation.

Bangalore
August 2020

M V Ravikumar

* This second edition includes two new segments: one on hygiene and another on nutrition and diet. The rest of the book is unchanged.

The Amazing Human Body

Our Amazing Body!

Many people think about their possessions and achievements more than the state of their bodies or minds. It is only when something goes wrong that we ever think about what part of our body is doing a certain action or how it does it. The human body can never stop working, even when at rest. The various systems of our body continues to function even without our thinking about them because a part of the brain is constantly active.

Our bodies respond to the environment around us – people with whom we live and work and the physical conditions in which we find ourselves. Although our bodies work well if fed and watered, we can improve or harm ourselves by the manner in which we eat, exercise, and rest. Many diseases that we suffer are partly caused by what we do to ourselves.

KNOW YOUR BODY SYSTEMS

We can define body systems as *groups of organs and tissues that work together to perform important jobs for the body*. There are some organs in our body which are part of more than one body system as they serve more than one function. Apart from these, other organs and tissues serve only one purpose in the body system. All body systems are necessary for the body to be able to survive and reproduce.

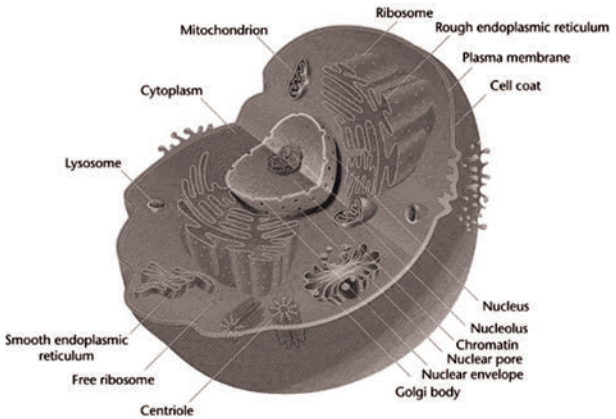
There are ten major body systems –

1. Nervous System
2. Circulatory / Cardio-vascular System
3. Digestive System
4. Excretory System
5. Respiratory System
6. Endocrine System
7. Exocrine / Integumentary System
8. Musuclo-skeletal System
9. Lymphatic / Immune System
10. Reproductive System

KNOW YOUR CELLS

A cell is the smallest structural and functional unit of an organism. The human body comprises about 100 trillion cells, which is thirty times more than the number of stars in the known galaxy.

The human brain alone is estimated to contain 80 billion cells. Every minute, more than 200 million cells die in the human body. But the body creates 300 billions more every day. Cells are self-sustaining and can replicate on their own through cell division. This means that every ten years your body will have changed completely.



Cells are the building blocks of living organisms. They provide structure to the body, take in nutrients from food, and carry out important functions.

The human body is made up of around two hundred different types of cells like blood cells, bone cells, fat cells, skin cells, stem cells, etc. Each type has a different structure, size, shape,

and function. Within these cells, there are twenty different types of structures or *organelles*, which perform functions like energy production. Groups of similar cells form a *tissue* and tissues form *organs*. Different type of cells have different life spans – the top layer of the skin: thirty days, red blood cells: 120 days, liver cells: about eighteen months, and so forth. The longest living cell is the neuron; it has the same life span as that of the individual. Blood cells have the shortest life span; they die in less than a day.

The cell is a jelly contained in an extremely thin skin or *membrane*. It is made up mostly of water, some sugars, and proteins. Apart from the thin membrane, the other two main parts of a cell are the *nucleus* and the *cytoplasm*. The nucleus carries all the instructions for cell activity and hence it is the control centre for cell chemistry; it directs the cell in the task it is doing. The cytoplasm is the semi-solid jelly that makes up most of the cell and this is where nearly all the cell chemistry takes place. The cytoplasm houses many tiny structures called *organelles*, which are sites for chemical processes. The thin cell membrane controls what enters and leaves the cell. It regulates the delivery of the

material from which the cell will build complicated compounds.

The longest cell in the body is the *motor neuron*. It measures 0.1 millimetre in diameter and about 1 metre in length. It is a nerve cell responsible for relaying impulses from the brain or spinal cord to a muscle or gland. This human cell is almost twice as long is the world's shortest adult. The largest cell in the human body is the female egg, at about 0.12 millimetre in diameter; it is visible to the naked eye. It's as big as a full stop (period). The sperm cell is the smallest human cell. And the most efficient ones are the heart muscle cells.

When a cell in the human body is damaged or undergoes some type of infection, it will self destruct by a process called *apoptosis*. This ensures proper development and checks the body's natural process of cell division.

A cell in your body regenerates itself without any prompting. This means we get new taste buds every ten days, new nails every six to ten months, new bones every ten years, and even a new heart, every twenty years!

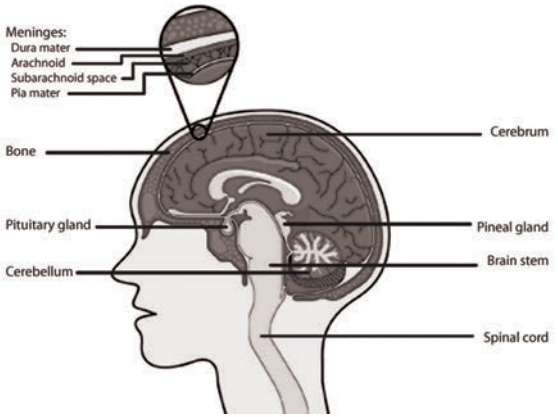
Nervous System

The nervous system is the most complex part of human body coordinating sensory information and actions, voluntary and involuntary. The nervous system comprises the central nervous system, consisting of the brain and spinal cord and the peripheral nervous system consisting of the cranial, spinal, and peripheral nerves, together with their motor and sensory endings. The nervous system has three main functions: sensory, integration and motor.

KNOW YOUR BRAIN

Over the course of human evolution, our brain size has tripled. The human brain will grow three times its size in the first year of life. It continues to grow till we are eighteen years old. The brain is only about 2% of the body mass, but uses 20% of the oxygen and blood. It is a myth that humans

only use 10% of our brain. We actually use all of it. We use more than 10% even when we sleep.



The brain uses about the same amount of power as a 15 Watt light bulb. If the brain's cortex were laid out flat, it would be about the size of a newspaper page.

About 75% of the brain is made up of water. This means that dehydration even in some amounts can affect the brain functions.

A human brain can do more computations per second than a powerful supercomputer. Older brains aren't slower because they're weaker, but because they hold more information.

The brain can't feel pain. Headaches are caused by a chemical reaction in your brain combined with the muscles and nerves of the neck and head.

The human brain gets smaller as we get older. This usually happens sometime after middle age. The brain begins to lose some memory abilities as well as some cognitive skills by the time we're in our late twenties.

Dreams are believed to be a combination of imagination, psychological factors, and neurological factors. They prove that your brain is working even when you are sleeping. The brain can survive for up to six minutes after the heart stops.

> ***The brain does not stop working. It is estimated that every day 60,000 thoughts pass through our brain, which amounts to more than forty thoughts a minute!***

KNOW YOUR SENSES

Senses are a collection of sensory organs or cells that respond to particular physical occurrences. Senses send information collected to various parts of the brain where the data is interpreted and an appropriate response signal is returned.

The exact number of senses humans have is disputed due to the various definitions of what a 'sense' is. It is widely agreed, however, that there are five main human senses: sight, hearing, taste, touch and smell. The five main sense organs are: *eyes*, *ears*, *tongue*, *nose*, and *skin*.

Sight or vision is the ability of the eye to detect and focus on images of visible light with photo-receptors found in the retina of the eye. Electrical nerve impulses are generated for different colours, hues and brightness.

The two types of photo-receptors are *rods* and *cones*. Rods are sensitive to light. Cones identify different colours. It is generally agreed that these two receptors are two senses, one sense for colour and one for brightness, which together make up the overall sense of sight.

Having 20/20 vision, the standard for normal visual acuity, means you can clearly see an image—like the letters on an eye chart—from a distance of twenty feet. Having 20/60 vision means you need to be three times closer (six and a half feet away) to see the same letters clearly.

Colour-blindness is ten times more common in men than in women. One in twenty men is at least partially colour-blind. All babies are colour-blind at birth.

Our eyes blink 28,000 times a day, each one lasting for one tenth of a second. This is a voluntary body reflex to keep the eyes clean and moist!

Hearing is a sense that detects the vibrations of sound. Mechano-receptors in the inner ear in the form of tiny bones and hair-like fibres turn motion or sound waves from the air into electrical nerve pulses that the brain can then interpret. A large meal will temporarily weaken your hearing.

The **taste** of food is detected by sensory cells called taste buds located on top of the tongue. There are five basic tastes: *sweet*, *bitter*, *sour*, *salty*, and *savoury*. While receptors for the five basic tastes do exist, they're not confined to specific areas but are distributed across the tongue.

Glands in our mouth produce an incredible 1.5 litres of saliva every day! If this did not happen, our mouth would dry up, become over run with bacteria and we would not be able to digest the food that we eat.

Our taste buds die and regenerate every few days. As we age, the cycle slows, dulling the ability to taste, which explains why older people tend to like their foods more salty and spicy.

Smell, like taste, is deemed to be a chemical sense. There are hundreds of olfactory receptors or sensory cells in our nasal passage, each of which will bind itself to a different molecular smell feature. Around 80% of what we think is taste is actually smell. Flavour, is a combination of taste and smell perception.

The sense of **touch** is activated by neural receptors such as hair follicles found in the skin and by pressure receptors on the tongue and throat. The skin is the body's largest organ and contains more than four million sensory receptors.

Among the body's most sensitive areas are the lips, the back of the neck, the fingertips, and the soles of the feet. The least sensitive is the middle of your back.

Being touched can reduce stress, by lowering levels of hormones like cortisol. Pain is the body's warning system. People have more receptors for pain than for any other sensation. Thermo-receptors perceive sensations related to temperature. But they stop being stimulated when the surface of the skin

drops below 41°F / 5°C (which is why your skin starts to feels numb in icy temperatures) or rises above 113°F / 45°C (at which point pain receptors take over to avoid burns).

The other perceived human senses are debatable but generally include, the ability to detect *temperature*, *pain*, *balance*, and *kinesthetics* (the relative positions of our body parts; test this sense by closing your eyes and touching your nose with a finger).

There are many internal body stimuli that may be perceived as senses too. For example, chemoreceptors for detecting salt and carbon dioxide concentrations in the blood and stretch receptors in the lungs that control our breathing rate.

Even small noises cause the pupil of the eye to dilate. This may be why surgeons, jewelers, and others who perform delicate manual operations tend to be bothered by uninvited noise. It subtly blurs their vision.

Circulatory System

The circulatory system or cardiovascular system, circulates blood through the body. The blood transports nutrients, oxygen, carbon dioxide, and hormones to and from the cells in the body. This provides nourishment, helps in fighting diseases, and stabilizes temperature and pH, thus maintaining homeostasis. The circulatory system is made up of blood vessels that carry blood in and out of the heart. *Arteries* carry blood away from the heart and *veins* carry blood back to the heart.

The heart is a pump, usually beating about sixty to a hundred times per minute. Heartbeat is controlled by a system of electrical signals in the heart. The *sinus node* is a small area of tissue in the wall of the right *atrium*. It sends out an electrical signal to start the contracting (pumping) of the heart muscle. This node is called the *pacemaker* of the heart because it sets the rate of the heartbeat

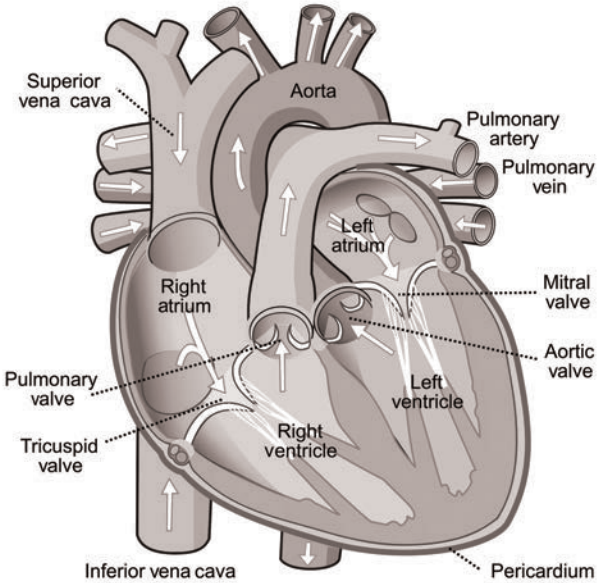
and causes the rest of the heart to contract in its rhythm. With each heartbeat, the heart sends blood throughout the body.

The *systemic* circulation provides the functional blood supply to all body tissues. The *pulmonary* circulation is the circulatory system of the lungs in which oxygen-depleted blood is pumped away from the heart—via the *pulmonary artery*—to the lungs and oxygenated blood is returned to the heart via the *pulmonary vein*. The pump for the pulmonary circuit, which circulates blood through the lungs, is the right *ventricle*. The left ventricle is the pump for the systemic circuit, which provides the blood supply for the tissues and cells of the body. A separate system known as the *bronchial circulation* supplies blood to the tissue of the larger airways of the lung.

The brain has a dual blood supply that comes from arteries at its front and back. These are called *anterior* and *posterior* circulation respectively. Anterior circulation arises from the *internal carotid arteries* and supplies blood to the front of the brain. Posterior circulation arises from the *vertebral arteries* that supplies blood to the back of the brain and the brainstem. The circulation from the front and the back join together at the *Circle of Willis*.

KNOW YOUR HEART

The heart starts beating at four weeks after conception and does not stop until death.



An adult heart beats about sixty to eighty times per minute. The heart beats about 100,000 times per day (about three billion beats in a lifetime). The heartbeat of a newborn (about 70 to 190 beats per minute) is faster than in adults. A woman's heart typically beats faster than a man's. The heart of an

average man beats approximately seventy times a minute, whereas the average woman has a heart rate of seventy-eight beats per minute.

Grab a tennis ball and squeeze it tightly; that's how hard the beating heart works to pump blood. The "thump-thump" of a heartbeat is the sound made by the four valves of the heart closing.

Because the heart has its own electrical impulse, it can continue to beat even when separated from the body, as long as it has an adequate supply of oxygen.

A human heart is roughly the size of a large fist. The heart weighs between 250 and 350 grams. The physician Erasistratus of Chios (*c.* 304–250 BCE) was the first person to discover that the heart functioned as a natural pump. The heart pumps out about 60 ml of blood at every heartbeat and about 5.7 litres of blood throughout the body. On average, it takes about forty-five seconds for blood to circulate from the heart, all around the body. During an average lifetime, the heart will pump nearly 1.5 million barrels of blood—enough to fill 200 train tank cars.

75 trillion cells in the body receive blood from the heart; only the corneas receive no supply of blood. Approximately 5% of the blood supply goes

to the heart, 15–20% goes to the brain and central nervous system, and 22% goes to the kidneys.

A study showed that vegetarians were 32% less likely to be admitted to the hospital or die from heart disease. Prolonged lack of sleep can cause irregular jumping heartbeats also known as *Premature Ventricular Contractions* (PVCs). Heart cancer is extremely rare because heart cells don't divide. Drug use, particularly cocaine, affects the heart's electrical activity.

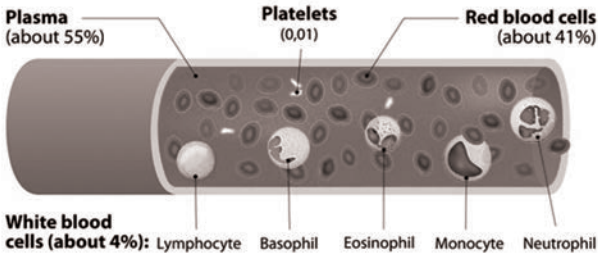
Every day, the heart creates enough energy to drive a truck for twenty miles. In a lifetime, that is equivalent to driving to the moon and back.

The human heart pumps about 7,571 litres of blood through its chambers every day and it beats 100,000 times to achieve this!

KNOW YOUR BLOOD

The blood of humans is red in colour but other organisms have blood of varying colours. Crustaceans, spiders, squids, octopuses, and some arthropods have blue coloured blood. Some types of worms and leeches have green blood. Some

species of marine worms have violet blood. Insects, including beetles and butterflies, have colourless or pale-yellowish blood. The colour of blood is determined by the type of *respiratory pigment* used to transport oxygen via the circulatory system to cells. The respiratory pigment in humans is a protein called *haemoglobin* found in red blood cells.



Blood has a number of functions that are vital for survival, including – *supplying oxygen to cells and tissues*; *providing cells with essential nutrients* such as amino acids, fatty acids, and glucose; and *protecting the body* from infection and foreign bodies through the white blood cells.

In humans, all blood cells originate from *hematopoietic stem cells*. About 95% of the body's blood cells are produced in the bone marrow. In an adult, most of the bone marrow is concentrated in

the breast bone and in the bones of the spine and pelvis. Several other organs help regulate the production of blood cells. These include the *liver* as well as the *lymphatic system* structures such as the *lymph nodes*, *spleen*, and *thymus*.

The adult human body contains approximately five litres of blood. The blood makes up about 7–8% of the total body weight. The blood circulating in the body is composed of about 55% *plasma*, 40% *red blood cells*, 1% *platelets*, and 4% *white blood cells*. Of the white blood cells in blood circulation, *neutrophils* are the most abundant.

Matured human blood cells have varying life cycles. Red blood cells circulate in the body for about four months, platelets for about nine days, and white blood cells range from a few hours to several days.

Unlike other types of cells, mature red blood cells do not contain a *nucleus*, *mitochondria*, or *ribosome*. The absence of these cell structures leaves room for the hundreds of millions of haemoglobin molecules found in red blood cells.

Exposing a person's skin to the sun's rays reduces blood pressure by causing levels of *nitric oxide* to rise in the blood. Nitric oxide helps regulate blood pressure by reducing *blood vessel tone*.

Human blood contains atoms of metals such as iron, chromium, manganese, zinc, lead, and copper. Human blood also contains small amounts of gold. In fact, the human body has about 0.2 mg of gold that is mostly found in the blood.

There are four major blood groups determined by the presence or absence of two antigens – **A** and **B** – on the surface of red blood cells. In addition to the **A** and **B** antigens, there is a protein called the *Rh factor,* which can be either present (+) or absent (–), creating the eight most common blood types –

A+ A– B+ B– O+ O– AB+ AB–

Red Blood Cells literally shoot around the body taking just sixty seconds for the full body circuit. Each RBC thus makes 1,440 trips every day. These cells live for forty days making about 60,000 trips, before they are replaced by fresh ones.

Digestive System

The digestive system is important because the body absorbs nutrients – *carbohydrates*, *proteins*, *fats*, *vitamins*, *minerals*, and *water* from the food (and fluids) that we consume. It then use all of that for energy, growth, and cell repair. The digestive system is made up of the *gastro-intestinal* (GI) *tract*, *liver*, *gall bladder*, and *pancreas*. The GI tract is a series of hollow organs joined in a long, twisting tube from the *mouth*, *oesophagus*, *stomach*, *small intestine*, *large intestine*, *rectum*, and *anus*. The liver, gall bladder, and pancreas are the solid organs of the digestive system.

Food moves through the GI tract by a process called *peristalsis*. The large, hollow organs of the GI tract contain a layer of muscle that enables their walls to move. The movement pushes food and liquid through your GI tract and mixes the contents within each organ. The muscle behind

the food contracts and squeezes the food forward, while the muscle in front of the food relaxes to allow the food to move.

Bacteria in the GI tract (also called *microbiome*) help with digestion. The digestive system works together with bacteria, nerves, blood, and hormones to digest the food and liquids that we consume.

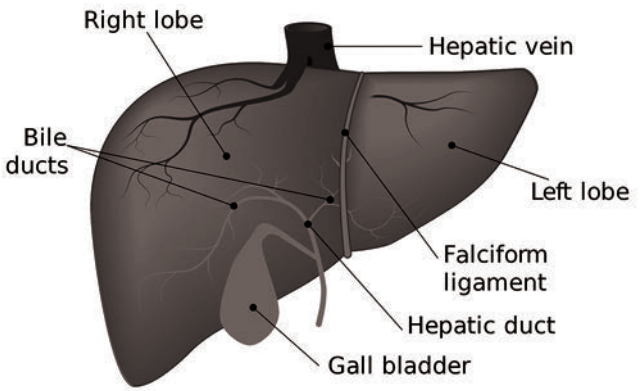
We eat our food in the sequence of appetizers, salads, main course, and dessert. But food is not digested in that order. The amount of time the food stays in each part of the digestive tract is different for each type of food that we eat. This makes it difficult to estimate the amount of time it takes for the food to be completely digested.

KNOW YOUR LIVER

THE HUMAN LIVER is a vital organ. It is so important that we cannot survive if it stops functioning for a single day. Unfortunately, it is also one of the least thought about organs. The liver has at least five hundred distinct functions in the body. It is an organ that is also a gland, creating important chemicals for its many processes.

The liver is the largest organ inside your body. It looks like a reddish brown wedge with two

different parts, or *lobes*, of different sizes. The right lobe is a lot bigger than the left lobe.



Two large blood vessels called the *hepatic artery* and the *portal vein* carry blood to the liver. The hepatic artery brings oxygen-rich blood straight from the heart through the *aorta*. The portal vein also brings blood but this is carrying digested food from the small intestine. As these blood vessels come into the liver they branch out and get smaller until they end in incredibly tiny *capillaries*. Each capillary leads to a *lobule* and each lobule is made up of *hepatic cells*. These are the basic cells of the liver and they do the most amazing things for the body. Liver makes glucose from the carbohydrates that we

eat, such as bread or rice. Some of this glucose travels in the blood to the rest of the body, where it is used for generating energy. The liver cleans the blood by taking out the *toxins*. The liver sorts things out and chemically changes them into what the body can use; and what can't be used, the liver turns them into something that dissolves in the blood so that they can be carried to the kidneys.

Some of the glucose is stored in the liver as *glycogen* and it is stored until your body needs to use extra energy, like when you have to run fast, react quickly, or have to physically work hard for a long time. It also helps to keep blood glucose at the right levels.

The *gall bladder* is a pear-shaped organ located on the under surface of the liver. The gall bladder functions as a concentrating reservoir for bile, which it delivers to the duodenum in response to *neuro-harmonal signals*.

The liver has the amazing ability to regenerate itself, which is what makes liver transplant possible. When people donate half their liver, the remaining part of the liver regenerates the section that was removed.

KNOW YOUR GI TRACT

From the mouth, the food moves down the oesophagus and into the stomach. When we eat something, the food doesn't simply fall through the oesophagus into the stomach. The muscles of the oesophagus constrict and relax in a wave-like manner called *peristalsis*, pushing the food down through the small canal and into the stomach.

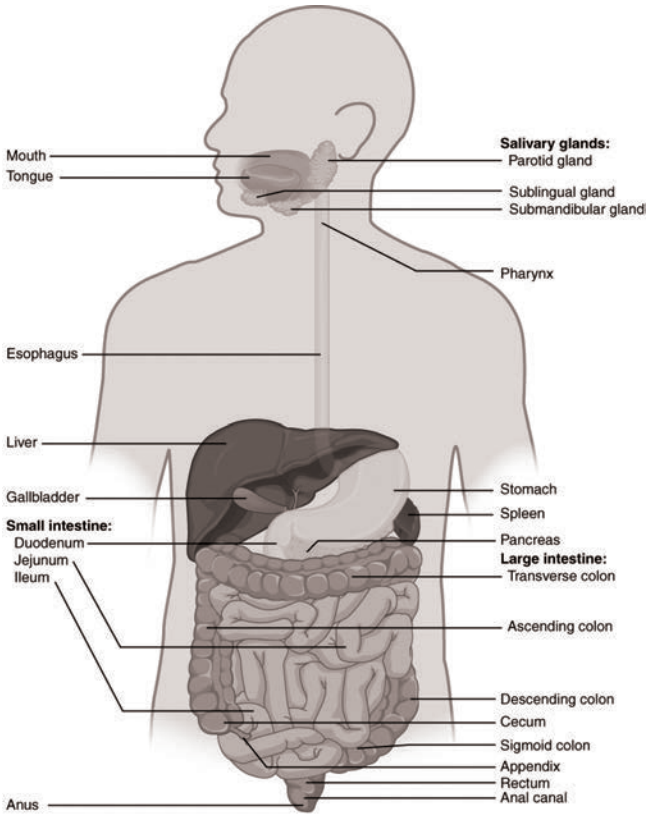
> ***Our digestive system starts working even before we put the food in our mouth. It takes six to eight hours for the food to pass through the stomach and two days to complete the digestion process!***

The stomach is a muscular bag whose primary function is food storage. It secretes *hydrochloric acid*, *mucus*, and *digestive enzymes*, which sanitize the food, breaks it down, and churns it into what is called *chyme*. The *gastric folds* in the stomach help move the food along the digestive tract. The stomach doesn't do most of the digestion. Cells along the inner wall of the stomach secrete roughly two litres of hydrochloric acid each day,

which helps kill bacteria and aids in digestion. To protect itself from the corrosive acid, the stomach lining has a thick coating of mucus. But this mucus can't buffer the digestive juices indefinitely, so the stomach produces a new coat of mucus every two weeks.

The chyme moves through to the small intestines. It is let in through the *pyloric sphincter* at a slow rate in order for the small intestines to do its vital task of imbibing the nutrients. The small intestine is the place where majority of the nutrients are absorbed. Small intestines are longer than any human being. It measures about twenty-two feet (seven meters) long and about an inch in diameter. The surface area is around 2,700 square feet (250 square metre), which is roughly the size of a tennis court.

The first section of the small intestine is called the *duodenum* and this is where most of the final breakdown of food occurs. The pancreas sends *bicarbonate* (to neutralize the acid from the stomach), *lipases* (enzymes to break down fats), *proteases* (enzymes that break down proteins) and *amylases* (enzymes that break down carbohydrates). The liver and the gall bladder send *bile* to the duodenum.



The *jejunum* is the middle section of the small intestine. Its interior surface is covered with tiny projections called *villi*, which provide extra surface area for absorption of nutrients. By the time all

the chyme passes through this part of the small intestines, 90% of the nutrients have been absorbed.

The *ileum* is the final section of the small intestine. At the end is the *ileocecal valve*, a one-directional portal that lets the remains of the chyme move into the large intestines. This juncture is the only place in the small intestine where Vitamin B12 and bile are absorbed.

The *enteric nervous system* or second brain is made up of over 100 million nerve cells that monitor the digestive system from oesophagus to anus. It is said to have more neurons than even the spinal column. Although this second brain can act on its own controlling the gut independently, it is actually in constant communication with our big brain.

The remains of the food enter the *colon*. In the colon, water, nutrients, and vitamins are absorbed from the remainder of the food. Through fermentation, the bacteria in the colon produce Vitamins K, B1, B2, and B12. After the colon completes its job, what remains leaves the body in the form of *faeces*.

Excretory System

The excretory system is a passive biological system that removes excess and unnecessary materials from the body to help maintain *internal chemical homeostasis* and to prevent damage to the body. Excretion in humans is carried through different parts and in a series of processes.

The human body is a truly exceptional machine where different life-processes (respiration, circulation, digestion, etc.) take place simultaneously. And as a result, the waste products produced in our body are in various forms that include *carbon dioxide*, *water*, and *nitrogenous products* like *urea*, *ammonia*, and *uric acid*. The excretory system is responsible for the elimination of these wastes. There are several parts of the body that are involved in this process, such as *sweat glands*, the *liver*, the *lungs*, and the *kidney system*.

KNOW YOUR KIDNEYS

The kidneys love the flow of blood. They absorb blood and redistribute 99% of the volume throughout the body, leaving the 1% to become urine. Kidneys have a higher blood flow compared to the brain or liver. About 25% of the blood from the heart flows into the kidneys.

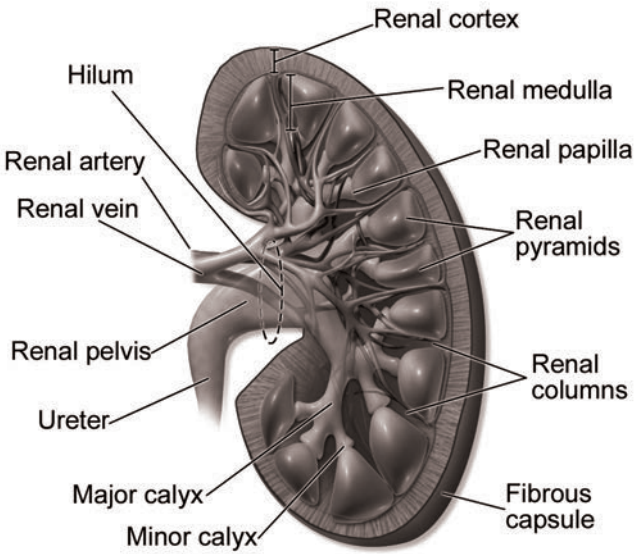
An adult's kidney weighs about 142 g and is of the size of a fist. If a baby is born with only one kidney, when it grows up, the kidney will weigh about 280 g – roughly the weight of two.

The tiny filtering unit is called *nephron*. There are about 1.15 million nephrons in each kidney. If stretched from end to end, these nephrons will measure five miles in length. Nephrons remove harmful toxins and excess fluids from the blood.

The *bladder* can hold 50–500 ml of urine and once it is half full, a signal is sent to the brain to release the same. On an average, kidneys expel about a litre and a half of urine every day.

The kidneys take thirty minutes to filter the entire volume of blood in the body. The blood is

The kidneys work together to filter about 1.3 litres of blood every minute, which means 1,872 litres every single day!



therefore filtered forty-eight times a day. Kidneys pump nearly 1,515 litres of blood every day.

The kidneys also regulates the body's sodium and potassium contents. *Tubules*, the second part of the nephrons absorb the *electrolytes* – *Sodium Chloride*, *Sodium bicarbonate*, *Potassium*, and *Calcium*. These electrolytes can conduct *electrical pulses* in the body. Kidneys also produce *hormones* that enable creation of red blood cells.

If skin cells fail to produce Vitamin D from sun light, the liver produces it. If the liver also fails, the kidneys provide Vitamin D as a last resort.

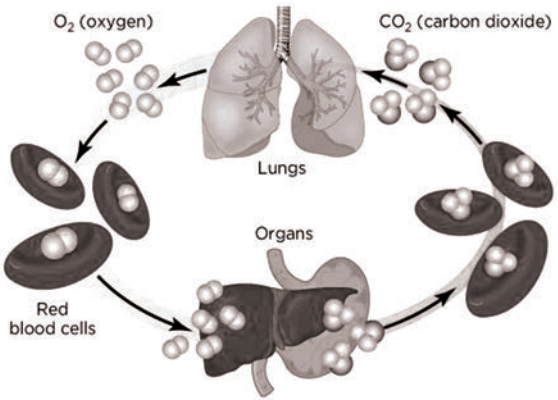
Respiratory System

We need energy to fuel all the activities in our bodies, such as contracting muscles and maintaining a resting potential in our neurons. We have to work to obtain the energy we use. Green plants draw their energy directly from sunlight and convert it into *carbohydrates*. We cannot do that, but we can use the energy stored in carbohydrates to fuel all other reactions in the body.

To do this, we need to combine *sugar* with *oxygen*. And so, we must accumulate both sugar and oxygen, which requires us to work. We spend much of our energy obtaining the sugar and oxygen we need to produce energy.

Breathing is central to life, as it allows the human body to obtain the energy it needs to sustain itself and its activities. Breathing uses chemical and mechanical processes to bring *oxygen* to every cell of the body and get rid of *carbon dioxide*, which is a waste product. The respiratory system, with its

conduction and *respiratory zones*, brings air from the environment to the lungs and facilitates gas exchange both in the lungs and within the cells.



Our respiratory system comprises a *conduction zone* and a *respiratory zone*. The conduction zone brings air from the external environment to the lungs via a series of tubes through which the air travels. These are the –

i. *Nasal cavity*
ii. *Pharynx* (part of the throat behind the mouth and the nasal cavity)
iii. *Larynx* (voice box)
iv. *Trachea* (windpipe)
v. *Bronchi* and *bronchioles*.

In addition to conducting air to the lungs, these tubes also *warm the incoming air*, *filter out*

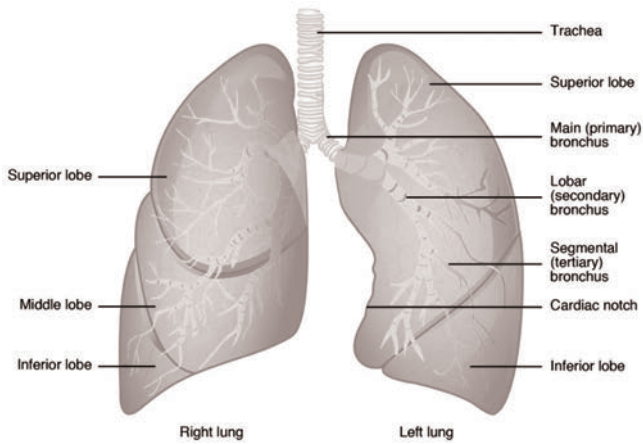
small particles from it, and *moisten it to ease the gas exchange in the lungs*.

The nasal cavity has a large number of tiny *capillaries* that bring warm blood to the cold nose. The warmth from the blood diffuses into the cold air entering the nose and warms it.

KNOW YOUR LUNGS

A PERSON BREATHS on an average six litres of air in a minute. An average adult takes about sixteen breaths a minute and it varies depending on the type of activity undertaken.

The two lungs are not symmetrical; the right one is slightly bigger than the left one. While the right one has three lobes, the left has only two.



Lungs are big organs; when spread out fully, they can cover a tennis court. It is the brain that controls the lungs and tell it how much it should inhale or exhale. That is the reason we experience different breathing rates even without intention. The lung is the only organ that can float on water. This is because the lungs will have one litre of air even after exhaling.

The body uses just 5% of the oxygen that we inhale and the rest goes out when we exhale. Every hour we exhale about 17 ml of water and in a day, that amounts to around half a litre! Through breathing, the lungs eliminate about 70% of the waste.

The lungs are always filled with blood and hence can enable the growth of bacteria. *Mucus* produced by the lungs helps combat the bacteria to keep the diseases away and also ensures that the lungs do not dry out. Coughing ten times in a day is normal for an average person.

The lungs are connected to our mouth through the connection of the *wind pipe* and *oesophagus*. In addition to breathing, the lungs help in talking. The *larynx* (voice box) is located above the wind pipe, so when air is pushed from the lungs, it gets converted to sound. Breathing deeply into our lungs helps ease pain or stress and makes us relax.

Endocrine System

The endocrine system is made up of glands that secrete *hormones* into the blood. The blood then carries the hormones throughout the body. *Endocrine hormones* are chemical messengers that control many body functions including *metabolism*, *growth*, and *sexual development*.

KNOW YOUR HORMONES

Hormones get a bad rap for a variety of conditions, from the rapid, awkward changes we experience at puberty to the mood swings associated with *pre-menstrual* or *menopause* syndromes. But without them, we would never grow, have libidos, or reproduce, just to name just a few key human experiences. The body's hormones and the glands that produce them, make up the Human Endocrine System.

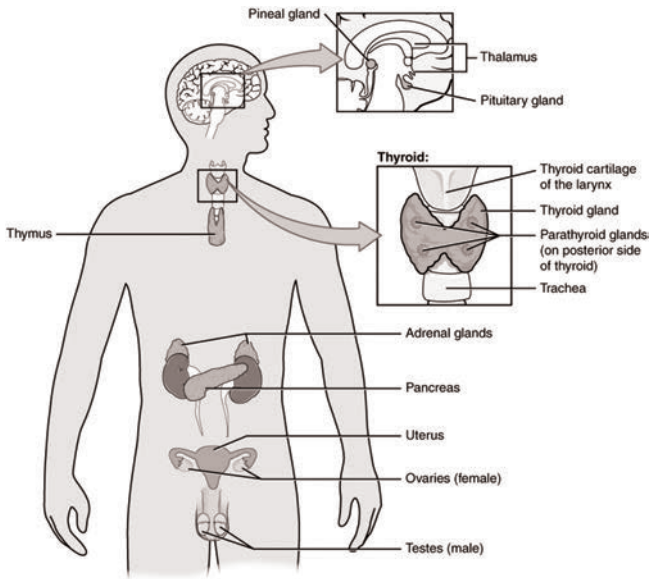
Endocrine glands release their products—*hormones*—directly into the bloodstream, without the help of *ducts*. There are eight major endocrine glands and their job is to regulate the body's *metabolism*, *reproduction*, *growth*, and *sleep*. Like the nervous system, the endocrine system is an *information signal system*. But rather than using neurons, it uses chemical messengers called *hormones*, each of which has its own unique function.

KNOW YOUR ENDOCRINE GLANDS

The eight hormone-secreting glands of the endocrine system are –

- *Adrenal gland*
- *Pancreas*
- *Parathyroid gland*
- *Pineal gland*
- *Pituitary gland*
- *Reproductive glands* (*ovaries* and *testes*)
- *Thymus*
- *Thyroid gland*

Some other organs and tissues that are not generally considered part of the endocrine system also secrete hormones.



The *hypothalamus* (a small region in the brain) plays a significant role in the endocrine system. It is responsible for maintaining the body's internal balance, which is known as *homeostasis*. To do this, the hypothalamus helps stimulate or inhibit many of key processes of the body including –

- Heart rate and blood pressure
- Body temperature
- Fluid and electrolyte balance, including thirst
- Appetite and body weight

- Glandular secretions of the stomach and intestines
- Production of substances that influence the pituitary gland to release hormones
- Sleep cycles

Pituitary gland is the 'brain' of the endocrine system. It regulates all seven other glands and secretes the *growth hormone*.

Thyroid regulates the metabolic rate, which is the amount of energy expended daily by a person at rest.

Thymus assists in the development of the immune system. Unlike most organs, the thymus is at its largest in children. Once the child reaches puberty, the thymus starts to slowly shrink and gets replaced by fat.

The thymus gland will not function throughout a full lifetime but it has a huge responsibility when it is active. It helps the body protect itself against *auto-immunity*, which occurs when the immune system turns against itself. So the thymus plays a vital role in the *lymphatic system* (the body's defence network) and the *endocrine system*.

Before birth and throughout childhood, the thymus is instrumental in the production and maturation of *T-lymphocytes* or *T-cells*, a specific

type of white blood cell that protects the body from certain threats, including viruses and infections. The thymus produces and secretes *thymosin*, a hormone necessary for *T-cell* development and production.

Adrenal gland regulates the fluid and sodium balance within the body and secretes *epinephrine* ('*adrenaline*') when the body is under stress, producing the 'fight-or-flight' response.

Ovaries (in females) and *testes* (in males) control the development of secondary sex characteristics.

Pancreatic islets regulate blood sugar.

Pineal gland regulates bio-rhythms and mood and stimulates the onset of puberty.

Parathyroid glands are four small glands of the endocrine system that regulate the calcium in our bodies. Parathyroid glands are located in the neck behind the thyroid where they continuously monitor and regulate blood calcium levels.

Exocrine System

Organs of the exocrine system (also called integumentary system) include the *skin*, *hair*, and *nails*.

The skin is the largest organ in the body. It encloses and protects the body and is the site of many sensory receptors. The skin is the body's first defense against *pathogens*. It also helps regulate body temperature and eliminates wastes through sweat.

The pancreas has both endocrine and exocrine functions. It releases a number of hormones, including *insulin* and *glucagon*, directly into the bloodstream. It also secretes a *pancreatic juice* that contains important digestive enzymes via ducts into the small intestine.

Musuclo-skeletal System

The skeletal system of an adult human consists of 206 bones, 32 teeth, and a network of other structures that connect the bones together. This system performs a number of vital functions, such as giving the body its form, assisting with bodily movements, and producing new blood cells. The bony skeletal system in humans is hidden under layers of skin and muscle.

Adults have 206 bones in their bodies but the same is not true for infants. The skeleton of a newborn baby has approximately 300 different components, which are a mixture of bones and *cartilage*. The cartilage eventually solidifies into bone in a process called *ossification*. For example, the knee-caps of newborns start off as cartilages and become bones in a few years. Over time, the 'extra' bones fuse to form larger bones, reducing the overall number of bones to 206 by adulthood.

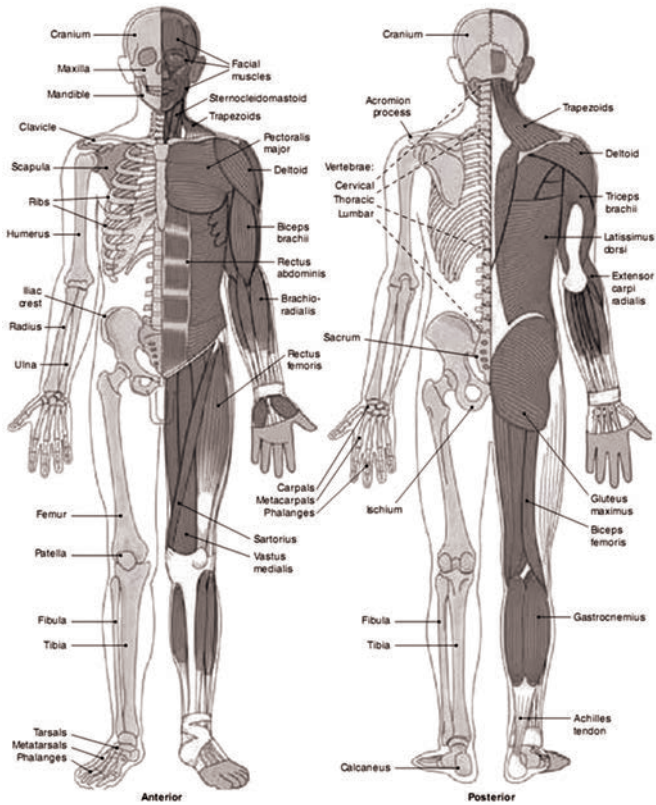
Bones are strong and rigid, and are built to withstand a lot of force. Pound for pound, bone is stronger than steel. However, they are *not* the hardest substance in the body. Bones come in all shapes and sizes and are not evenly distributed throughout the body. Some areas have far more bones than others. Hands and feet have the most number of bones.

Each hand has twenty-seven bones and each foot has twenty-six, which means that together the body's four limbs have 106 bones, which is more than half the bones in the entire body.

Most adults have twenty-four ribs (twelve pairs), but about one in every 500 people has an extra rib called *cervical rib*. This rib, which grows from the base of the neck just above the *collar-bone*, is not always fully formed; it's sometimes just a thin strand of tissue fibres.

The *hyoid* is a horse-shoe shaped bone in the throat situated between the chin and the *thyroid cartilage*. It's also the only bone in the human body not connected to another bone. The hyoid is often considered the anatomical foundation of speech; because of where it is located, it can work with the *larynx* (voice box) and *tongue* to produce the range of human vocalizations.

Bones are made of active, living cells. Like the other cells in your body, bone cells are susceptible to benign tumours and even cancer. But this is nothing new. Modern humans and their relatives have dealt with tumours for thousands of years.



Muscles allow us to move. *Stomach muscle* movement facilitates digestion and *cardiac muscle* movement facilitates heartbeat. The movement of these muscles is directed by the *autonomic part* of the nervous system – those are the nerves that control organs. *Skeletal muscles* move our bodies in space. They take direct instruction from the specific nerves that innervate each muscle.

The muscles that move the human skeleton vary greatly in shape and size and extend to every part of our bodies. The muscular system contains over 600 skeletal muscles alone, which make up about 40% of our mass. Blood vessels and nerves run to every muscle, helping control and regulate each muscle's function.

In the muscular system, skeletal muscles are connected to the skeleton, either to bone or to connective tissues such as *ligaments*. Muscles are always attached at two or more places. When the muscle contracts, the attachment points are pulled closer together; when it relaxes, the attachment points move apart.

The *contraction* and *relaxation* of muscles makes the bones to move. The elbow joint bends when muscles pull on the *radius* and *ulna* bones in the forearm. Muscles contract when messages travel

from nerves to muscles and trigger chemical reactions. These reactions change the internal structures of the *muscle fibre cells*, a process that shortens the muscle. The muscle fibres relax when the nervous system signal is no longer present, thus reversing the shortening.

Not all muscle tissue is skeletal muscle. *Smooth muscle* (a type of muscle tissue) is found in the walls of many organs and helps those organs move, to facilitate body functions. The *alimentary canal*—*i.e.*, oesophagus, stomach, and intestines—includes muscle tissue that contracts and relaxes to move nutrients during the digestion process. The *urinary bladder* also includes muscle tissue that contracts and relaxes to hold and release urine. Heartbeats are the result of the contraction and relaxation of muscle tissue in the heart wall. Smooth muscle in the walls of arteries help move blood through the body.

The *cerebral cortex* sends a signal through the spinal nerve to the nerves that innervate muscles around the elbow joint. When that signal reaches the muscle tissue, its cells reorganize, causing a contraction that bends the elbow joint.

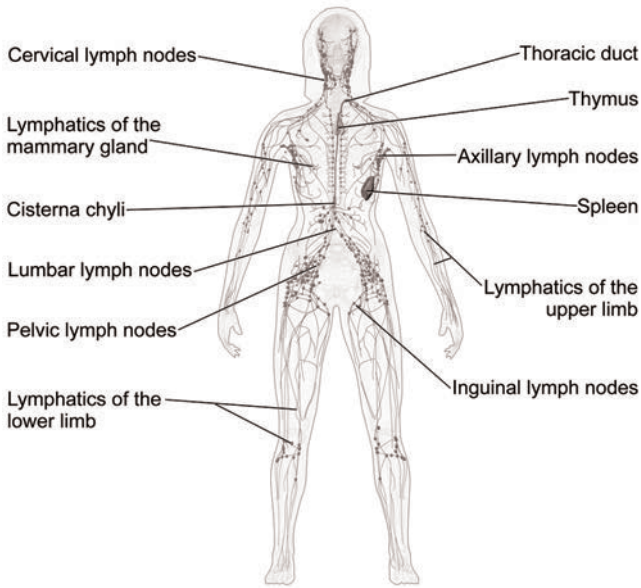
Lymphatic System

The lymphatic system of the human body is sometimes considered to be part of the *immune system*. It consists of a network of *lymph vessels* and *ducts* that collect excess fluid (called *lymph*) from extra-cellular spaces in tissues and transport the fluid to the bloodstream. The lymphatic system also includes many small collections of tissue called *lymph nodes* and an organ called the *spleen*, both of which remove *pathogens* and *cellular debris* from the lymph or blood. In addition, the *thymus gland* in the lymphatic system produces some types of white blood cells (*lymphocytes*) that fight infections.

The lymphatic system is a network of tissues and organs that help rid the body of *toxins*, *wastes*, and *unwanted materials*. The primary function of the lymphatic system is to transport lymph, a fluid containing infection-fighting white blood cells, throughout the body.

The lymphatic system primarily consists of *lymphatic vessels*, which are similar to the *veins* and *capillaries* of the circulatory system. The vessels are connected to *lymph nodes*, where the lymph is filtered. The *tonsils*, *adenoids*, *spleen*, and *thymus* are all part of the lymphatic system.

There are hundreds of lymph nodes in the human body. They are located deep inside the body, such as around the lungs and heart, or closer to the surface, such as under the arm or in the groin.



Lymph nodes are found from the head to around the knee area.

The spleen which is located on the left side of the body just above the kidney is the largest lymphatic organ. The spleen acts as a blood filter. It controls the amount of red blood cells, regulates blood storage in the body, and helps fight infections. If the spleen detects potentially dangerous bacteria, viruses, or other microorganisms in the blood, it creates—along with the lymph nodes—white blood cells called *lymphocytes*, which act as defenders against invaders. The lymphocytes produce *antibodies* to kill the foreign micro-organisms and stop infections from spreading.

KNOW YOUR BACTERIA AND VIRUSES

It may be hard to fathom but the human body is occupied by large collections of micro-organisms, commonly referred to as *microbiome*, which have evolved with us since the early days of man. Scientists have only recently begun to quantify the microbiome and discovered it is inhabited by at least 38 trillion bacteria.[1] Bacteria are not the most

1 R, Fuchs S, Milo R (2016) *Revised Estimates for the Number of Human and Bacteria Cells in the Body*. PLoS Biol 14(8): e1002533. *https://doi.org/10.1371/journal.pbio.1002533*

abundant microbes that live in and on our bodies. It has been estimated that there are over 380 trillion viruses[2] inhabiting us, a community collectively known as the *human virome*.

But these viruses are not the dangerous ones you commonly hear about, like those that cause the flu or the common cold, or more sinister infections like ebola or dengue. Many of these viruses infect the bacteria that live inside our body and are known as *bacteriophages*, or *phages* for short. The human body is a breeding ground for phages that kill bacteria. They take over the bacteria's machinery and force them to make more phages rather than make more bacteria. When they are done, they burst out of the bacterium, destroying it. Finally, these phages sit on our body surfaces just waiting to cross paths with vulnerable bacteria. They are basically bacteria stalkers.

When our healthy bacterial communities are disturbed by antibiotic use, other microbial villains, also called *pathogens*, take advantage of the opportunity to invade our body and make us unwell.

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2 John L Mokili, Forest Rohwer, Bas E Dutllh (2012), *Metagenomics and future perspectives in virus discovery*, Current Opinion in Virology, Volume 1, Issue 2, February 2012, *pp*. 63–77

Therefore, in a number of human conditions, our healthy bacteria play important roles in preventing pathogen intrusion.

So the race is on to find those viruses in our viromes that have already figured out how to protect us from the villains, while leaving the good bacteria intact. Indeed, there are recent anecdotal examples utilizing phages successfully to treat life-threatening infections from bacteria resistant to most if not all available antibiotics – a treatment known as *phage therapy*. Unfortunately, these treatments are and will continue to be hampered by inadequate information on how phages behave in the human body and the unforeseen consequences their introduction may have on the human host. Thus, phage therapy remains heavily regulated. At the current pace of research, it may be many years before phages are used routinely as anti-infective treatments.

The viruses that have evolved with us for so many years are not only part of our past, but will play a significant role in the future of human health.

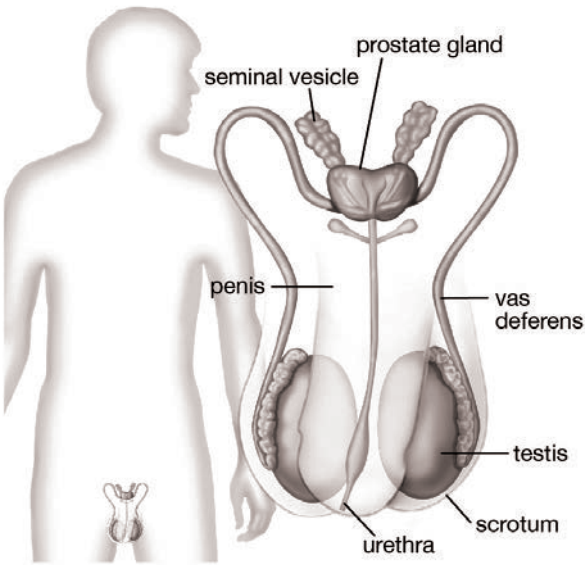
Reproductive System

The reproductive system includes the male reproductive system that functions to produce and deposit *sperm* and the female reproductive system that functions to produce *egg cells* and also protect and nourish the *foetus* until birth.

A small portion of the *semen* (male) that contains *sperm cells* pass through the *cervix* into the *uterus* and then into the *Fallopian tubes* for the fertilization of the *ovum* (female). Only one sperm is required to fertilize the ovum. Upon successful fertilization, the fertilized ovum (called *zygote*) travels out of the Fallopian tubes and into the uterus, where it gets implanted in the uterine wall. This marks *pregnancy*, which continues for around forty weeks as the foetus develops. Pregnancy is concluded with child's birth involving *labour*. During labour, the muscles of the uterus contract and the cervix dilates over the course of hours and the baby passes out of the *vagina*.

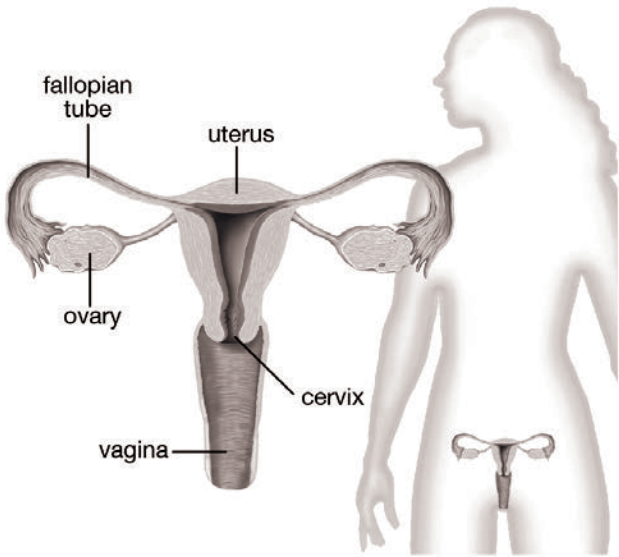
The reproductive system is a collection of *internal organs* and *external genitalia* that work together to generate new life. Like most species, human beings have two sexes: male and female. The male reproductive system consists of *a pair of testes*, *ducts*, *accessory glands*, and a *penis*.

The functions of the male reproductive system are production of sperms and transmission of sperms to the female.



The female reproductive system consists of *two ovaries* (which produce *ova* and *female hormones*), *Fallopian tubes*, *uterus* (muscular organ that supports the foetus during its forty-week *gestation period* before birth), *vagina*, and *external genitalia*.

The functions of the female reproductive system are production of ovum, receiving the sperms, providing a suitable environment for fertilization of sperm and egg, child birth, and nourishment of the baby with breastmilk until it can take to a mixed diet.



Humans like any other species, pass their unique characteristics to the next generation through their *genes*.

The reproductive system contains the largest and the smallest human cells (gametes).

Males produce the smallest human cell, the *sperm*, which is only five micrometers by three micrometers in size, not including the sperm's 'tail.' The red blood cell is about eight micrometers in diameter, which is about a tenth of the diameter of a human hair. A female's *ovum* or egg is the largest human cell and is at about 120 micrometers in diameter.

The average pH of the vagina is 4.5, which mean it is acidic. The vagina is home to numerous micro-organisms that can thrive only in an acidic environment, such as the bacteria *Lactobacillus*, which produces *lactic acid*. Without these beneficial bacteria standing guard, other *pathogenic* (disease-causing) bacteria could enter and take over the vaginal ecosystem.

The *testicles* are not only vital for reproduction but also for normal development during puberty,

for they produce various sex hormones. In particular, the *testes* produce *testosterone*, which is responsible for the development of secondary sex characteristics, including voice deepening and the growth of facial and body hair.

Besides producing the *germ cells* (or *gametes*), the ovaries and testes are the source of hormones that cause full development of secondary sexual characteristics and also the proper functioning of the reproductive tracts.

A HUMAN FEMALE can give birth to about thirty-five babies in a lifetime. Female ovaries contain about one to two million eggs at birth but only three hundred thousand make it to puberty. An ovum can have a lifespan of 12–24 hours after it is released from the ovary, while a sperm can have a lifespan of 36 hours. *Fertilization* is mostly possible when the female is at the middle of her *menstrual cycle*. This is when hormones promoting pregnancy are at their peak.

A female *uterus* is normally three inches long and two inches wide. During pregnancy the uterus can expand up to twenty times its normal size. The uterus contains one of the strongest muscles in the

female body. *Fallopian tubes* are about 12 cm long and only as wide as a sewing needle.

A healthy male testis can produce around five hundred million sperm cells daily and these testes can release up to seventy-five million or more sperm cells during an *ejaculation*. The process of sperm production (*spermatogenesis*) requires an optimal temperature which is around 2–3°C lower than the normal human body temperature. This is why the *scrotum*, which contains the testicles, is present outside the body.

At eight weeks of pregnancy, the vital organs like brain, heart, skin, and stomach are all developed within the *embryo*, which is then the size of an adult thumb. The health of the foetus and its development are affected by the mother's oral health. When in the womb, the baby's body is covered by a thin layer of hair that disappears when the baby is born.

KNOW YOUR BIRTH

At the moment of fertilization, a baby's genetic make-up is complete, including its sex. The sex of the baby depends on what sperm fertilizes the egg at the moment of conception. Generally, women

have a genetic combination of XX and men have XY. While the woman provides X, man provides X or Y.

Within 24 hours after fertilization, the egg begins rapidly dividing into many cells. It remains in the Fallopian tubes for about three days after conception. Then the fertilized egg (now called a *blastocyte*) continues to divide as it passes slowly through the Fallopian tubes to the uterus. Within three weeks, the blastocyte cells ultimately form a little ball, or an *embryo*. By this time, the baby's first nerve cells have formed.

As the fertilized egg grows, a water-tight sac forms around it, gradually filling with fluid. This is called the *amniotic sac* and it helps cushion the growing embryo. During this time, the *placenta* also develops. The placenta is a round, flat organ that transfers nutrients from the mother to the baby, and transfers wastes from the baby to the mother. By the end of the first month, baby is about ¼ inch long – smaller than a grain of rice!

During weeks 5-8, the neural tube (brain, spinal cord, and other neural tissue of the central nervous system) is well formed. The digestive tract and sensory organs also begin to develop.

At about 6 weeks, the baby's heartbeat can usually be detected. By the end of the second

month, the baby is about an inch long and weighs about a gram. Now the embryo is called *foetus*.

By the end of the third month, the baby is fully formed. All the organs and limbs (extremities) are present and will continue to develop in order to become functional. The baby's circulatory and urinary systems are also functional and the liver produces bile. At the end of the third month, baby is about four inches long and weighs about thirty-two grams.

The eye-lids, eye-brows, eye-lashes, nails, and hair are formed. The baby can even suck his or her thumb, yawn, stretch, and make faces. The nervous system is starting to function. The reproductive organs and genitalia are now fully developed, By the end of the fourth month, baby is about six inches long and weighs about 130 g.

During the fifth month, the baby is developing muscles and start exercising them. Hair begins to grow on the baby's head. The baby's skin is covered with a whitish coating called *vernix caseosa*. This 'cheesy' substance is thought to protect the baby's skin from the long exposure to the *amniotic fluid*. At the end of month five, the baby is about ten inches long and weighs between 250 and 450 g.

During the sixth month the baby's translucent skin is reddish in colour, wrinkled, and veins are visible. The eye-lids begin to part and the eyes open. The baby responds to sounds by moving or increasing the pulse. At the end of sixth month, baby will be twelve inches long and weigh about 900 g.

In the month seven, the baby's hearing is fully developed. The baby changes position frequently and responds to stimuli, including sound, pain, and

light. The amniotic fluid begins to diminish. At the end of the seventh month the baby will be fourteen inches long and weigh between 1 to 2 kg. If it is born prematurely, the baby is likely to survive.

In the eighth month the baby will continue to mature and develop reserves of body fat. The brain is developing rapidly at this time and the baby can see and hear. Most internal systems are well developed but the lungs may still be immature. The baby will be eighteen inches long and may weigh as much as 2.2 kg.

During the ninth month, the baby will continue to grow and mature. The lungs are close to being fully developed at this point. The baby's reflexes are coordinated so s/he can blink, close the eyes, turn the head, grasp firmly, and respond to sounds, light, and touch. The baby may be 17–19 in. long and weigh between 2.5 and 3 kg.

In the beginning of the tenth month, the baby's position may have changed to prepare for birth. Ideally, the baby is head down in the uterus. The mother may feel extremely uncomfortable in this final stretch of time as the baby drops down into the pelvis and prepares for birth. At this point, the baby is ready to meet the world.

Hygiene

Good hygiene involves keeping all parts of the external body clean and healthy. It is important for maintaining both physical and mental health. In people with poor personal hygiene, the body becomes the ideal place for germs to grow, leaving it vulnerable to infection. At a social level, a person with poor personal hygiene might be avoided by others, which may result in isolation and loneliness.

Generally there are five types of hygiene one should practice as a routine –

Dental hygiene involves having more than white teeth. For a healthy mouth and beautiful smile, brush you teeth for two minutes *after* every meal. Irrespective of your age, you can use a children's toothbrush; it has soft bristles that are teeth-friendly and being small, it can access all corners of your mouth. It will help to massage

the gums and clean the tongue once a day. Good dental hygiene helps in preventing gum diseases, cavities in teeth, and bad breadth.

Body hygiene involves keeping the body clean by taking a shower or a bucket-bath daily, using soap and water to rinse away dead skin cells, oil, and bacteria. Several million sweat glands cover the body and when bacteria break down the sweat, the process creates a bad smell. That is the reason one should pay special attention to areas that accumulate more sweat, such as the armpits, the webs of the toes and fingers, and the groin area. Washing the hair once or twice a week is advisable. Irrespective of your age, you may use baby soap and shampoo, for they are gentle on the skin and hair.

Washing the hands prevents many of the communicable diseases. The five simple steps to be followed for effective hand washing are –

i. Wet the hands with clean, running water, then turn off the tap and apply soap.

ii. Lather the hands by rubbing them together with the soap, remembering to reach the backs of the hands, between the fingers, and under the nails.

iii. Scrub the hands for at least twenty seconds, which you can time by humming the *Happy Birthday to you* song twice.

iv. Rinse the hands well under clean, running water.

v. Dry the hands using a clean towel or air dry them.

It is always safer to wash your hands –

– before, during, and after preparing the food

– before and after eating

– before and after using the toilet

– before and after treating a cut or a wound

– before coming in contact with infants or elderly people

– after handling garbage, touching dirty surfaces, or coming in contact with unclean objects

– after blowing your nose, coughing, or sneezing

– after handling pets or items related to pets

– when you get back home after travelling outside.

Finger- and Toe-nails may harbour dirt and germs, contributing to the spread of bacteria. They have to be cut short or kept clean on a regular basis. This will help in reducing the risk of spreading infections. It is easier to cut your nails after taking a shower or a bath.

Personal hygiene varies for men and women –

For Women: The vagina can clean itself and no special care is needed, other than washing the external genitals. During menstruation, wash your body—including your genital area—in the same way as you always do. Change sanitary napkins regularly, at least four to five times a day. Always wash your hands before and after handling a sanitary pad.

For Men: A build-up of secretions called smegma can form under the foreskin of uncircumcised men. If you are uncircumcised, gently pull back the foreskin when you have a shower and clean with water. You can use soap if you like, but make sure you rinse it off well.

Nutrition and Diet

Nutrition is the science that interprets the nutrients and other substances in food related to maintenance, growth, reproduction, health, and disease. It includes ingestion, absorption, assimilation, biosynthesis, catabolism, and excretion. Diet is combination of various food items that one eats and drinks depending on the palatability, availability, and affordability. A healthy diet consists of all seven classes of nutrients that human body requires – *carbohydrates*, *fats*, *fibre*, *minerals*, *protein*, *vitamins*, and *water*. Healthy diet also includes preparation of food and storage methods that prevent nutrients from oxidation. Nutrients are further classified as *macro-nutrients* (large quantity) and *micro-nutrients* (very small quantity) depending on the need of the human body.

The food that we eat is primarily used for maintaining and regenerating the cells of the

body and for generating the energy we require for undertaking various physical and mental tasks.

In humans, an unhealthy diet can cause deficiency-related diseases such as blindness, anemia, scurvy, pre-term birth, still-birth, and cretinism (congenital iodine deficiency syndrome). Nutrient excess can cause health-threatening conditions such as obesity and metabolic syndrome as well as common chronic systemic diseases like cardio-vascular disease, diabetes, and osteoporosis.

KNOW YOUR DIET

To BE HEALTHY and active, we need a *Balanced Diet*. In other words, our diet must be adequate in quantity and variety to meet our energy and nutrition needs. Most foods contain many different nutrients; no single food—except the mother's milk—provides all the nutrients required. The best way to ensure that the body gets all the necessary nutrients is to eat a variety of healthy foods.

Where do we find the nutrients?

Carbohydrates are the basic source of energy. They range in complexity from simple sugars to complex starches. Sugars are found in sweet foods such as honey, milk, and fruits. Major sources of

starches include cereals, root vegetables, pulses (beans, lentils, peas), and some fruits such as plantains and bananas.

Fibre is a member of the carbohydrate family and plays an important role in regulating the digestive process, lowering blood sugar, reducing cholesterol, as well as preventing haemorrhoids and even cancer. Sources of fibre are greens, leafy vegetables like cauliflower, cabbage, peas, and ladies finger, as well as whole wheat and brown rice.

Fats are rich sources of energy and provide essential fatty acids. They can be obtained from both animals and plants. Animal sources include fatty meats, poultry such as duck and goose, butter, ghee, and oily fish. Plant sources include oil-seeds (sunflower, safflower, sesame), nuts, and legumes (peanuts, soybeans).

Proteins are long chains of amino acids that form much of the basic structural material of the body. They are essential for the body's growth, functioning, and repair. The body can itself create many amino acids but some essential ones must be obtained from food. Different foods contain varying quantities of amino acids. Animal products are a prime source of protein but a mixture of vegetable sources can also satisfy the body's needs.

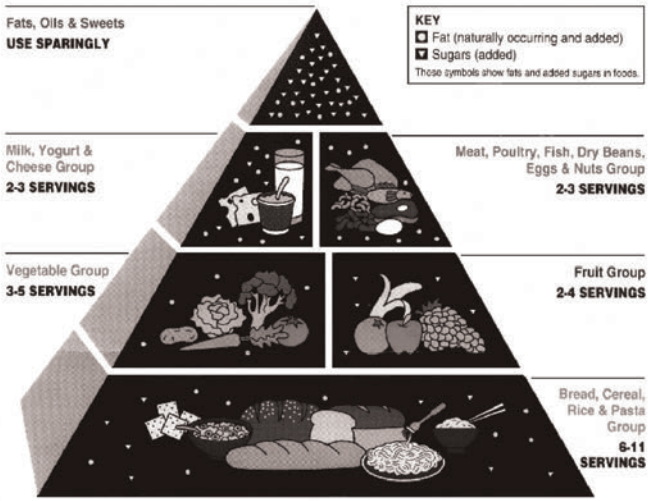
Rich sources of proteins include meat, fish, dairy products, pulses, nuts, and cereals.

Vitamins are essential to practically all the chemical processes in the body and for maintaining the health and integrity of body tissue. Vitamins are usually required in small quantities but should be consumed regularly because many of them are not stored well in the body. Vitamin-A is found only in animal products, particularly liver, eggs, and milk; many fruits and vegetables such as carrots, mangoes, and papaya contain *carotene,* a chemical that the body converts into Vitamin-A. Good sources of Vitamin-C are fruits and vegetables. The B-complex is found in cereals, legumes, meat, poultry, and dairy products.

Minerals are essential to structures such as bones and teeth (calcium) as well as processes such as energy transfer (iron) and functioning of the body and brain (iodine). We need comparatively larger amounts of some minerals like *calcium*—found in peas, beans, milk, meat, and cheese—and much smaller amounts of others like *iron*—found in meat, fish, shellfish, dark green leafy vegetables, and nuts.

Vitamins and minerals are micro-nutrients; usually they are needed in only small quantities.

Water is an essential nutrient and plays an important role in maintaining fluid and electrolyte homeostasis of the body. Water accounts for 70% of our body weight. It is a constituent of blood and other vital body fluids. Water plays a key role in elimination of body wastes and regulation of body temperature. Water intake includes that which is consumed as food and beverage, along with relatively small volumes of water created by the oxidation of food (metabolic water) and breakdown of body tissue. For a healthy adult, drinking eight glasses (two litres) of water per day is optimum.



UDSA Diet Pyramid

A healthy diet includes nutrient-dense foods from all major food groups, including lean proteins, whole grains, healthy fats, nuts, and multi-coloured fruits and vegetables. The ten benefits of having healthy diet are –

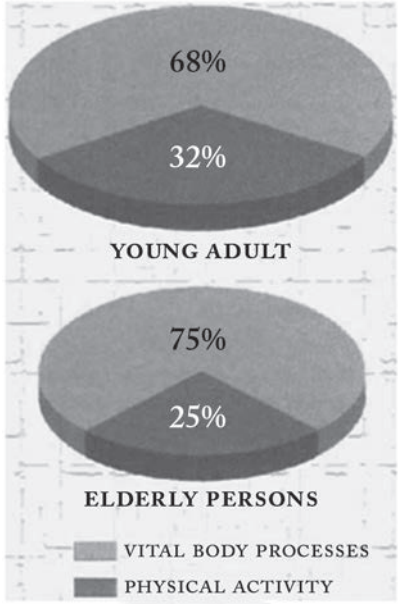
1. Getting a good night's sleep
2. Strong bones and teeth
3. Healthy heart
4. Better mood
5. Improved gut health
6. Improved memory
7. Weight management
8. Diabetics management
9. Reduced cancer risk
10. Ensuring health of next generation

It is the food that we eat, water that we drink, and air that we breathe that determines the quality of our physical life.

ENERGY REQUIREMENTS

THE HUMAN BODY carries out its main functions by consuming food and turning it into usable energy. Immediate energy is supplied to the body in the form of *adenosine triphosphate* (ATP). Since ATP is the primary source of energy for every body function, other stored energy is used to replenish

ATP. There are only small amounts of ATP in the body, so it is necessary to have sufficient energy stores for backup. The amount of daily energy the body requires depends on the individual's daily energy consumption and metabolic requirements, which can be estimated by body weight and activity level. The basic energy consumption of the human body is 4 kJ/kg (kilojoule per kilogram) of body weight per hour. Typical distribution of energy spent for young adults or elderly person is schematically shown.



The Human Mind

Theory of mind is an important social-cognitive skill that involves the ability to think about mental states, both your own and those of others. It encompasses the ability to attribute mental states, including emotions, desires, beliefs, and knowledge. Not only does the theory of mind involve thinking about thinking but it also refers to the ability to understand that other people's thoughts and beliefs may be different from your own and to consider the factors that have led to those mental states.

Forging a strong theory of mind plays an important role in our social worlds as we work to understand how people think, to predict their behaviour, to engage in social relationships, and to solve interpersonal conflicts.

Mind is a system through which individual manages instincts, emotions, and intelligence.

Though it has some bearing on the family in which the individual is born and the environment in which s/he grows up, it is definitely possible to develop the right mindset to suit one's nature and convenience ensuring it does not affect others (including all living species and environment).

The instincts that have to be managed are the need for *food*, *sleep* (rest), and *sex*.

The emotions that have to be managed are – love, humour, compassion, anger, courage, sadness, disgust, surprise, and peace/ tranquility.

The types of intelligence (Howard Gardner, 1983) to be understood and managed are –

1. Naturalist (nature smart)
2. Musical (sound smart)
3. Logical/mathematical (reasoning smart)
4. Existential (life smart)
5. Interpersonal (people smart)
6. Bodily-kinaesthetic (body smart)
7. Linguistic (word smart)
8. Intra-personal (self smart)
9. Spatial (picture smart)

The mindsets of people who manage instincts, emotions, and intelligence can be categorized into four types –

I. Analytical – Knowledge driven
II. Accumulative – Wealth driven
III. Administrative – Control driven
IV. Accepting – Survival driven

Each of us, by nature, have more of one type of the mindsets and less of others. However, ideally we should possess all the four types for conducting our lives peacefully and use them in the right proportion for specific jobs, situations and persons with whom we interact.

For this, one should understand both *body* and *mind* and consciously learn to strike a balance between them.

AVOIDABLE ADDICTIONS

Today we seem to have an attitude that makes us feel that we are too rushed, too pressurized, or suffering too much, and that we must do something to reward ourselves or feel better. A variety of addictions like binge eating, compulsive shopping, mobile-phone usage, alcohol consumption, watching television, smoking, internet usage, drugs, and so forth make people believe that they are in control of life. They might be even trying to escape from their unhappy life.

Addiction takes over people's lives and those that are addicted become miserable. Their problems become even more serious, and what once helped them feel better quickly is ruining their lives slowly.

There are much better options to relax body and mind - walking amidst nature, reading good books, listening to music, painting, playing sports, meditation, yoga, friendship with the right people, etc.

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— SUMAN SRINIVASAN, PhD (Lecturer in Psychology)

PUBLISHED BY **Kaveri Trust**, Bengaluru

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